REMARKS

I. Introduction

The Office Action of December 22, 2010 has been reviewed and the Examiner's comments carefully considered. Claims 1-8, 16, and 17 were previously pending in this application. The present Amendment amends claim 1 and cancels claims 8 and 16. The amendments to claim 1 are in accordance with the originally-filed specification. No new matter has been added. Specifically, support for the amendment to claim 1 can be found in cancelled claims 8 and 16. Accordingly, claims 1-7 and 17 are currently pending, and claim 1 is in independent form. Based on the above amendment and the following remarks, the Applicants respectfully request reconsideration of the rejections set forth in the Office Action and allowance of pending claims 1-7 and 17.

II. 35 U.S.C. § 103 Rejection

Claims 1-8, 16, and 17 stand rejected under 35 U.S.C. § 103(a) for obviousness over United States Patent Application Publication No. 2003/0026063 to Munshi (hereinafter "the Munshi publication") in view of United States Patent No. 6,797,428 to Skotheim et al. (hereinafter "the Skotheim patent") and the article entitled "In situ SEM study of the interfaces in plastic lithium cells" to Orsini et al. (hereinafter "the Orsini article").

As defined by independent claim 1, the present invention is directed to an electricity storage device that includes a polymer electrolyte and polarizable electrodes. The polarizable electrodes each comprise an interface with the polymer electrolyte. The polarizable electrodes are metal electrodes. A negative electrode of the polarizable electrodes has, at its interface with the polymer electrolyte, a lithium alloy with a metal component contained in the negative electrode. The lithium alloy is capable of releasing lithium ions through a reversible electrochemical oxidation-reduction reaction. The negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component. The metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte, and the polymer electrolyte component is rich in a region in a vicinity of a center of the polymer electrolyte. The polymer electrolyte is sandwiched between the negative

electrode and the positive electrode. The negative electrode is constituted of a projecting part. The projecting part is formed in a boundary region with the polymer electrolyte, and the projecting part is in the shape of at least one of a fractal, peninsula, island with a neck-shaped constriction, tree, mushroom, icicle, polyp, and coral. A specific capacity of the electricity storage device is 20 F/cm^3 or more.

The Munshi publication is directed to an electrochemical capacitor (100) that includes a polymer thin film (12), a liquid electrolyte absorbed in the polymer thin film (12), and thin flexible active electrode layers constituting anode (10) and cathode (30) composed of energy dense material of high intrinsic surface area positioned at either side of the electrolyte-retaining polymer thin film (12) to tightly sandwich it between the electrode layers. The capacitor (100) includes a polymer electrolyte in which a polymer thin film (12) is cast from the base polymer and impregnated with the electrolyte solution, which contains a salt for ionic conduction (*see* FIGS. 1A-1C and 2).

Initially, independent claim 1 has been amended to require a specific capacity of the electricity storage device to be 20 F/cm^3 or more. In the electricity storage device of amended independent claim 1, the electrode has a fine uneven shape, such as a fractal or the like, and therefore has a very large surface area. Accordingly, the electricity storage device of amended independent claim 1 has a very large specific capacity (e.g., 20 F/cm^3 or more) which provides advantageous effects as compared with conventional storage elements due to the presence of (1) the electric double-layer capacity, and (2) the pseudo-capacity involved in an oxidation-reduction reaction. The Munshi publication, whether considered alone or in combination with the Skotheim patent and the Orsini article, does not teach or suggest an electricity storage device have a specific capacity of 20 F/cm^3 or more. On page 5 of the Office Action, the Examiner merely states that the combination of the Munshi publication with the Skotheim patent would inherently have such a high specific capacity. However, there is no teaching or suggestion in either of these references that the specific capacity would be 20 F/cm^3 or more.

Additionally, the Munshi publication, whether considered alone or in combination with the Skotheim patent and the Orsini article, does not teach or suggest that the negative electrode includes a lithium alloy with a metal component provided at the interface with the

polymer electrolyte or that the negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component where the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte, and the polymer electrolyte component is rich in a region in a vicinity of a center of the polymer electrolyte as required by independent claim 1. The Examiner admits that the Munshi publication fails to teach or suggest that the negative electrode includes a lithium alloy with a metal component provided at the interface with the polymer electrolyte on page 3 of the Office Action.

However, the Examiner contends that the Skotheim patent discloses the use of a negative electrode that comprises a lithium alloy with a metal component. While the Skotheim patent discloses an anode active layer that includes a first layer of lithium metal, a second layer of a temporary protective material, such as copper or gold, and a multilayer structure in contact with a surface of the second layer (*see* column 16, lines 24-45), there is no teaching or suggestion in the Skotheim patent that this lithium layer is provided at an interface with a polymer electrolyte as required by independent claim 1.

In addition, the capacitor disclosed in the Munshi publication, whether considered alone or in combination with the Skotheim patent and the Orsini article, does not have the same structure as the claimed electricity storage device. More specifically, the Munshi publication does not teach or suggest that the negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component where the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte, and the polymer electrolyte is rich in a region in a vicinity of a center of the polymer electrolyte as required by amended independent claim 1. The Skotheim patent and the Orsini article do not cure this deficiency.

Furthermore, the combination of the Munshi publication and the Skotheim patent does not teach or suggest that the negative electrode is formed in the polymer electrolyte such that the polymer electrolyte includes the metal component and a polymer electrolyte component; that the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte; and that the polymer electrolyte component is rich in a region in a vicinity of a center

of the polymer electrolyte as required by amended independent claim 1. However, the Examiner relies on the Orsini article as disclosing such a feature. The Examiner relies on the description in the Orsini article that during the charging of a lithium battery, tangled and ramified dendrites grow at the lithium-polymer interface as providing support for a conclusion that such dendrites would cause the lithium to be rich in the outer regions of the electrolyte and would cause the electrolyte to be rich in the center. However, there is no support for such a conclusion in the Orsini article. The Orsini article does not teach or suggest that the metal component is rich in a region in a vicinity of an outer side of the polymer electrolyte or that the polymer electrolyte is rich in a region in a vicinity of a center of the polymer electrolyte as required by independent claim 1.

In addition, independent claim 1 has been further amended to require the projecting part to be in the shape of at least one of a fractal, peninsula, island with a neck-shaped constriction, tree, mushroom, icicle, polyp, and coral. This shape is achieved through an electroless plating step to form an electrode having a large surface area. On the other hand, the Orsini article requires multiple free discharges to be performed to form dendrites. Therefore, the invention of independent claim 1 and the device described in the Orsini article are completely different in the electrode forming steps, thereby yielding a different structure and purpose for obtaining such a structure. More specifically, the Orsini article describes the formation of dendrites which are grown by linkage of lithium (metal component) alone. In contrast, the claimed invention requires a negative electrode made from a metal component, such as gold, lead, tin, zinc, etc., and a lithium alloy attaches to the surface of the metal component. Accordingly, the production process of the negative electrode of the claimed invention is quite different than the growth process of the dendrites described in the Orsini article, thereby leading to a structure that is different than what is described in the Orsini article.

Finally, there is no teaching or suggestion in the Orsini article that the polymer electrolyte is sandwiched between the negative electrode and the positive electrode as required by amended independent claim 1. Accordingly, one of ordinary skill in the art would not combine the teachings of the Orsini article with those of the Munshi application.

For the foregoing reasons, the Applicants believe that the subject matter of amended independent claim 1 is not rendered obvious by the combination of the Munshi publication, the Skotheim patent, and the Orsini article. Reconsideration of the rejection of claim 1 is respectfully requested.

Claims 2-7 and 17 depend from, and add further limitations to, amended independent claim 1, and are believed to be patentable for at least the reasons discussed hereinabove in connection with amended independent claim 1. Reconsideration of the rejection of claims 2-7 and 17 is respectfully requested.

III. Conclusion

Based on the foregoing amendments and remarks, reconsideration of the rejections and allowance of pending claims 1-7 and 17 are respectfully requested. Should the Examiner have any questions or wish to discuss the application in further detail, the Examiner is invited to contact Applicants' undersigned representative by telephone at 412-471-8815.

Respectfully submitted,

THE WEBB LAW FIRM

By _____

Ryan J. Miller
Registration No. 56,236
Attorney for Applicants
436 Seventh Avenue
700 Koppers Building
Pittsburgh, PA 15219
Telephone: (412) 471-8815
Facsimile: (412) 471-4094
E-mail: webblaw@webblaw.com